Speaker emotion can affect ambiguity production

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Running head: Emotion affects ambiguity production

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Abstract

Does speaker emotion affect degree of ambiguity in referring expressions? We used referential communication tasks preceded by mood induction to examine whether positive emotional valence may be linked to ambiguity of referring expressions. In Experiment 1, participants had to identify sequences of objects with homophonic labels (e.g. the animal *bat*, a baseball *bat*) for hypothetical addressees. This required modification of the homophones. Happy speakers were less likely to modify the second homophone to repair a temporary ambiguity (i.e. they were less likely to say…*first cover the bat, then cover the baseball bat…*). In Experiment 2, participants had to identify one of two identical objects in an object array, which required a modifying relative clause (*the shark that's underneath the shoe*). Happy speakers omitted the modifying relative clause twice as often as neutral speakers (e.g. by saying *Put the shark underneath the sheep.*) thereby rendering the entire utterance ambiguous in the context of two sharks. The findings suggest that one consequence of positive mood appears to be more ambiguity in speech. This effect is hypothesized to be due to a less effortful processing style favouring an egocentric bias impacting perspective taking or monitoring of alignment of utterances with an addressee's perspective.

Introduction

While there is a sizeable body of research examining how speakers *sound* depending on their affective state (Scherer, 2003), there is almost no research studying how speakers *formulate their messages* depending on their affective state. One component of message formulation concerns disambiguation of referents in situations where the context does not clearly disambiguate between several potential candidates for reference. Why should a link between ambiguity of referring expressions and affective state of the speaker be hypothesized in the first place? Given that emotional valence has been shown to affect processing styles (Bless & Igou, 2005; Bodenhausen, Mussweiler, Gabriel, & Moreno, 2001; Beukeboom & Semin, 2006) and cognitive control (Oaksford, Morris, Grainger, & Williams, 1996; Phillips, Bull, Adams, & Fraser, 2002), and given that perspective taking requires more effortful processing (Converse, Lin, Keysar & Epley, 2008), it is possible that emotional valence can modulate the degree of ambiguity in referring expressions that lack contextual disambiguation.

First insights into how emotional valence may affect speech production came from studies examining the effects of happy and sad mood on request formulation (Forgas, 1999a,b). The results showed that sad speakers produced less direct, more polite and more elaborate requests than happy speakers, and this difference was more pronounced in socially more complex situations with higher processing demands which required speakers to anticipate the reactions of their interlocutors to avoid rejection or to give offense, and to adjust the level of politeness and directness accordingly. It has been suggested that more polite and indirect request formulation may be the result of affect-congruent memories of previous communications, which can bias speakers' estimations of their current communicative success (Forgas, 1999a). This idea found further support in a study with high vs. low trait anxiety individuals, who had to convey one of two possible interpretations of lexically or syntactically ambiguous utterances, and were then asked to estimate how well they had succeeded in doing so (Fay, Page, Serfaty, Tai & Winkler, 2009). Low anxiety participants demonstrated actual success rates that were lower than perceived success rates, and signal detection analyses revealed that these participants were biased to overestimate their communicative success. High anxiety participants, on the other hand, estimated their communicative success more accurately. Although a stable trait like social anxiety is not quite the same as a transient mood like sadness, this finding suggests that the valence of affective states may serve as a source of information that biases a speaker's perception of the outcomes of their current communicational bids. Overestimating one's communicative success, in turn, may impact on the process of language production.

It has also been suggested that emotional valence affects processing styles directly: According to the 'affect-as-information' approach (Schwarz & Clore, 1988), negative emotions signal potential difficulties in problematic situations in which individuals would benefit from increased attention to detail. For example, the more deliberate, systematic and effortful processing associated with induced negative mood (Bless & Igou, 2005; Bodenhausen, Mussweiler, Gabriel, & Moreno, 2001) is associated with more concrete, and potentially more informative, descriptions of past events compared to speakers induced to experience positive mood (Beukeboom & Semin, 2006). Effortful processing also benefits perspective taking in comprehension. In a referential communication task, happy participants were more prone to egocentric interpretations of an interlocutor's expressions than sad participants (Converse et al., 2008), suggesting that happy mood is not conducive to the effortful processing required for perspective taking and Theory of Mind (Epley, Morewedge & Keysar, 2004).

If positive emotions reduce the likelihood of engaging in the more effortful processing required to track the mental state of an addressee then happy speakers should be more likely to produce expressions that could be ambiguous for potential addressees. In previous research, we found that when speakers were instructed to produce syntactically ambiguous sentences like *Touch the cat with the flower* in a visual context which contained a flower and two cats, one of which was holding another flower, they were less likely to produce disambiguating prosody that could clarify the intended meaning (flower as instrument of touching vs. as modifier of cat) the more their voices were rated as sounding happy (Kempe, Schaeffler & Thoresen, 2010). However, this study only provided correlational evidence for a link between expressed emotion and ambiguity production. Here, we test directly whether valence of induced mood can modulate a speaker's propensity to produce ambiguous utterances. We attempted to induce transient happy and sad mood prior to participants' production of referring expressions that could potentially contain a lexical (Experiment 1) or a syntactic (Experiment 2) ambiguity. Extrapolating from the evidence described above, we predicted that happy speakers should be more likely to produce ambiguous utterances.

Experiment 1

To examine the effect of emotional valence on lexical ambiguity production we adapted a methodology introduced by Ferreira, Slevc and Rogers (2005). Speakers saw an array of four object pictures and had to label two, three or four of them in a pre-specified order. Since amount of ambiguity production was not affected by physical presence of the addressee in Ferreira et al. (2005), we opted for hypothetical addressees because of concerns that interaction with another person could affect the mood induction in uncontrolled ways. In critical trials, two of the object names were homophones, e.g. the flying mammal bat and a baseball bat. We examined whether induction of happy or sad mood prior to this task would affect the extent to which speakers labelled the target nouns with bare homophones (e.g. *bat*), which are ambiguous for potential addressees. We also examined whether speakers disambiguated the utterance by modifying the subsequently to be labelled homophonic contextual foils (e.g. *baseball bat*).

Method

Participants: 48 undergraduate students (12 men), all native speakers of English, were randomly assigned to the sad and happy condition, matching for gender.

Materials: Mood induction. Mood induction procedures asking participants to recall sad or happy events have proven to be most efficient (Westerman, Spies, Stahl & Hesse, 1998). However, in order to prevent participants from producing verbal output which could prime their subsequent language production in uncontrolled ways, we chose a non-verbal mood induction. Pilot studies revealed that mood induction using classical music alone failed to elicit the desired mood in our undergraduate student population. We therefore combined classical music pieces used in the literature (e.g. Ferraro, King, Ronning, Pakerski & Risan, 2003) with cartoon clips. In the happy condition, participants watched the scene ‘Bambi on Ice’ from the animated movie *Bambi* (Walt Disney, 1942). The original soundtrack was muted and replaced with Mozart’s *Rondo in G*. In the sad condition, participants watched the scene ‘Death of

Simba' from the animated movie *The Lion King* (Walt Disney, 1994), accompanied by Barber's *Adagio for Strings*.

Production task: To keep overall task duration short enough for the induced mood to persist throughout, we selected twelve target and foil picture pairs from the set of eighteen homophone pairs used in Ferreira et al. (2005), using the Snodgrass and Vanderwart (1980) picture set. Six target-foil pairs (e.g. flying bat, baseball bat) were used in the ambiguous array; the remaining targets were combined with a non-homophone distractor for the control array. Materials were counterbalanced such that one half of the targets appeared in the control arrays in List A and in the ambiguous arrays in List B, and vice versa. In all trials, target and foil pictures were combined with two additional non-homophonic distractor pictures resulting in arrays of four pictures. In addition, we created 24 filler trials consisting of four pictures exclusively depicting non-homophonic nouns. To encourage participants to produce longer labels, half of the fillers contained at least one picture of a compound noun (e.g. *ironing board, rocking horse*).

On each trial, the four pictures were arranged in the top, bottom, left and right positions on a computer screen. Position of targets and foils was randomised across trials. The numbers 1, 2, 3 and 4 were placed next to each picture to indicate the order in which participants had to label the pictures. In the ambiguous and control conditions, the numbers prompted the participants to first produce two distractor nouns, followed by the target and then the foil. In filler trials, participants were prompted to name either two or three pictures, to prevent them from falling into a response set of always producing four nouns. Position of numbers was randomised across fillers. Presentation order of targets and fillers was randomised for each participant.

Procedure: Under the pretence of producing instructions for a new game, participants were told that their speech would be audio-taped and played back to prospective game testers to see how well these testers could follow the instructions. Participants were further told that the prospective testers would be asked to cover pictures presented to them on game boards containing identical picture arrays as those on the computer screen. Participants then saw a practice trial and sample instructions (e.g. *First cover the snail, then cover the window, then the carrot and then the book.*) Next, participants were fitted with a head-mounted JHS MUD-805 uni-directional headset microphone, and were told that to help them to relax and be at ease with the experimental requirements, they would now watch a short cartoon clip accompanied by some music. At the end of the clip, participants received four practice trials, followed by the 36 experimental trials. Their speech was recorded using an iRiver iHP-120, a multi-purpose mp3-player that allows uncompressed wave-format recordings. Sound files were recorded at a sampling rate of 44.1 kHz. During the mood induction and production phases of the experiment, the experimenter remained out of view of the participants so as not to interfere with the induced mood, and only re-appeared to administer the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988) which required participants to rate their current mood, on a scale from 1 to 4, using eight positive and eight negative mood adjectives. The BMIS was administered after the speech production, which lasted on average 5 min 47 sec (s.d. 1 min, 3 sec), to check whether the induced mood had persisted throughout the task.

Results and Discussion

Manipulation check: Following Niedenthal and Setterlund (1994) and Halberstadt, Niedenthal and Kushner (1995), we computed happy scores as the average rating of the BMIS-attributes *happy*, *active*, *lively*, *bubbly* and *content*, and sad scores as the average ratings for the attributes *sad*, *gloomy*, *tired* and *drowsy*. We then subtracted the sad score from the happy score yielding each participant's BMIS score. Higher scores reflect greater happiness. The difference in BMIS scores between participants in the happy (.82, s.d. .88) and in the sad mood condition (0.16, s.d. 1.20) was significant, $t(46) = 2.2$, $p < .05$. Note, however, that while the BMIS scores in the happy group differed significantly from 0, $t(23) = 4.6$, $p < .001$, the scores for the sad group did not ($p = .5$) suggesting that the mood induction was less successful in eliciting sad than happy mood. Thus, any effects of the mood induction should be interpreted as reflecting the difference between happy and neutral emotion.

Data analysis: Labels used to describe targets and foils were coded following the guidelines outlined in Ferreira et al. (2005). Labels for foils provide information about whether participants had repaired a temporary ambiguity created by labelling the target with a bare homophone or whether they had produced a completely ambiguous utterance. Percentage of bare homophones for target nouns in the control and for targets and foils in the ambiguous arrays are given in Table 1. In three cases participants supplied no response; these cases were treated as missing values. Data were analysed by fitting a logit mixed effect model with crossed random effects for participants and items. Homophone Type (control, target, foil) and Mood (happy vs. neutral) were included as fixed variables. The three levels of Homophone Type were coded using forward difference coding so that the proportion of bare homophones was compared between targets in the control and the ambiguous arrays and between targets and foils in the ambiguous arrays. The model also included random intercepts and slopes for subjects and items, where items were defined by the bare homophones presented in each array.

Insert table 1 about here

The results showed that targets were labelled less frequently with bare homophones in the ambiguous array compared to the control array ($\beta = -1.15$, $z = -2.40$, $p < .05$), and this effect did not interact with Mood. Thus, in line with findings by Ferreira et al. (2005), participants produced fewer homophones when two objects that could be labelled with the same homophone were present in the array. Furthermore, in the ambiguous arrays, foils, which appeared last, were labelled less frequently with bare homonyms than targets ($\beta = -1.82$, $z = -2.71$, $p < .01$) indicating that participants tended to disambiguate the second instance of the bare homophone (e.g. by saying *…cover the nail, then cover the fingernail…*), presumably due to their detecting the ambiguity after-the-fact and trying to avoid completely ambiguous expressions. Crucially, the interaction of this effect with Mood was significant ($\beta = -0.96$, $z = -2.15$, $p < .05$) suggesting that the participants in the happy condition were less likely to provide such after-the-fact disambiguation. This finding suggests that happy mood may give rise to more statements containing a lexical ambiguity compared to what speakers would normally produce. This is in agreement with the aforementioned finding that low social anxiety is associated with speakers' overestimating their communicative clarity while high social anxiety is associated with more realistic estimates (Fay et al., 2009).

Experiment 2

The aim of Experiment 2 was to see whether an effect of emotional valence on ambiguity production could also be observed in another domain -- the domain of syntactic ambiguity. As in Experiment 1, sentences were elicited under the pretence of providing game instructions. These instructions required participants to disambiguate potential referents on visual arrays containing duplicates of the same referent (see top panels of Figure 1) by using sentences that modified either the direct object (e.g. *Put the shark that's underneath the sheep underneath the shoe.* in an array with two sharks) or the oblique object (e.g. *Put the shark underneath the shoe that's underneath the sheep.* in an array with two shoes). These sentences afford two potential loci for ambiguity. Speakers can create a temporary syntactic ambiguity by producing reduced as opposed to unreduced relative clauses which contain the demonstrative pronoun *that*. For example, speakers can produce reduced relative clauses as in *Put the shark underneath the sheep underneath the shoe* in which the first prepositional phrase, *underneath the sheep*, can be interpreted either as oblique object or as modification of the direct object, *shark*, and only the visual context will disambiguate which interpretation is the correct one. In addition to producing this temporary syntactic ambiguity, participants could potentially also produce globally ambiguous instructions by omitting the object modification altogether as in *Put the shark underneath the shoe*.

Method

Participants. Forty-eight undergraduate students (24 men), all native speakers of English, were randomly assigned to the sad and happy conditions, matching for gender.

Materials: The materials consisted of arrays of pictures and arrows specifying the required direction of movement of pictures on the array. Twenty pictures corresponding to mono-syllabic nouns were selected either from the Snodgrass and Vanderwart (1980) picture set or from internet sources. On each array, five pictures were arranged on a 5 x 5 grid, the lines of which were invisible, such that some pictures were placed adjacent to each other and some not and an arrow pointed from one picture to an empty spot adjacent to another picture. To satisfy the requirements of an unrelated study, the critical pictures in each array constituted triplets of nouns in which the same phoneme preceded the vowels /i:/, /a:/ and /u:/ (*beard-barn-boot; heel-hoop-heart*, *peach-spoon-park*, *sheep-shark-shoe*). In the 16 critical trials, one of the pictures was present twice, and the arrows were arranged such that either the direct object picture (the picture to be moved) or the oblique object picture (the destination picture) had a duplicate (see top panels of Figure 1). Duplicates were placed adjacent to another picture, which could be used for disambiguation (e.g. *the shark that's underneath the shoe* as opposed to *the shark that's underneath the pen*). Spatial arrangements of pictures on the grid and position of target referent with respect to the adjacent picture (above or underneath) were counterbalanced resulting in four lists with 16 critical trials each. In addition, we created 16 fillers consisting of arrays with five unique pictures (see bottom panels of Figure 1). Half of the fillers invited the production of simple sentences as the arrow indicated movement of just one object (e.g. *Put the sheep above the pen.*); the other half invited the production of complex fillers as two arrows indicated simple movements of two objects (e.g. *Put the shark underneath the sheep and the shoe above the sheep*).

Arrays were printed on A4 paper and assembled into booklets corresponding to the four lists of 16 critical trials each. Each list was combined with the same 16 fillers. Order of presentation was quasi-randomised across lists such that all lists started and ended with fillers, and that no more than two critical trials appeared in succession. Each list also contained detailed written instructions to the participants, providing example sentences for two simple fillers, two complex fillers and two critical trials. For the critical trials, one example contained an unreduced relative clause, the other one a reduced relative clause; ordering of unreduced vs. reduced relative clauses in the instructions was counterbalanced across lists and types of modified object (direct vs. oblique).

Procedure: Participants were randomly assigned to a list and a mood condition, matching for gender. As in Experiment 1, they were told to provide game instructions to hypothetical addressees and then asked to study the instructions in the booklet. Next, the experimenter fitted participants with the head-mounted microphone and disappeared from their view before starting the mood induction video clip. At the end of the clip, participants turned the page to see the first array and started producing the instructions, which were audio-recorded. The production task lasted on average 3 min 51 sec (s.d. 60 sec); at the end the experimenter re-appeared to administer the BMIS.

Results and Discussion

Manipulation check: BMIS scores were computed in the same way as in Experiment 1. The difference in BMIS scores between participants in the happy (0.86, s.d. 0.82) and the sad mood condition (0.31 s.d. 1.06) was significant, $t(46) = 2.59$, $p < .05$. As in Experiment 1, the BMIS score in the happy condition was significantly above 0,

$t(23) = 5.1$, $p < .001$ while the score in the sad condition was not ($p = .2$) suggesting that for Experiment 2, effects of mood induction should again be interpreted in terms of differences between happy and neutral mood.

Data analysis: We coded whether participants produced an unreduced relative clause starting with the relative pronoun *that*. We also coded whether participants failed to modify the object thereby producing utterances that were completely ambiguous given the visual context. Table 2 shows the mean proportions of unreduced relative clauses and the mean proportions of omitted modifications for contexts requiring modification of direct and oblique objects.

Insert table 2 about here

Data were analysed by fitting two logit mixed effect models with crossed random effects for participants and items with the centered variables of Mood (happy vs. neutral) and Modified Object (direct vs. oblique) as independent variables to the unreduced relative clauses and to the omitted object modifiers, both coded as binary dependent variables. The models also included random intercepts and slopes for subjects and items, where an item was defined as a specific combination of nouns and prepositions regardless of specific spatial layout of the corresponding objects in the array. As predicted, the happy speakers produced slightly less unreduced relative clauses containing *that* (28%) than the neutral speakers (34%) but this difference in the production of unreduced relative clauses was not significant; there were no significant effects in the model. However, for presence or absence of object modifiers as dependent variable we found a significant effect of Mood ($\beta = -0.8$, $z = -2.12$, $p <$

.05). This, in accordance with our prediction, happy speakers failed to modify the object thereby producing completely ambiguous utterances 44% of times, twice as frequently as neutral speakers. Such unmodified utterances (e.g. *Put the shark underneath the sheep.*) are ambiguous not because they contain a syntactic ambiguity but because they completely fail to disambiguate the specific referent in a visual context containing two sharks.

General Discussion

Results from two experiments showed that the valence of speakers' affective state impacted ambiguity production. While happy and neutral speakers did not differ in the production of bare homophones on the first mention of a lexically ambiguous noun in Experiment 1, happy speakers were less likely to modify the second homophone thereby not disambiguating the entire utterance. Similarly, in Experiment 2, happy and neutral speakers did not differ in the use of 'that' to avoid the temporary ambiguity associated with a reduced relative clause but happy speakers were less likely to modify the object thereby producing entirely ambiguous utterances. These findings suggest that positive emotional states may increase ambiguity in referring expressions.

Why should happy mood increase ambiguity? In the Introduction, we noted that positive affective states tend to be associated with less deliberate processing (Bless & Igou, 2005; Bodenhausen, Mussweiler, Gabriel, & Moreno, 2001; Forgas, 1995) and reduced cognitive control (Oaksford et al., 1996; Phillips et al., 2002). Below, we will briefly sketch a few possibilities of how this may affect language production.

First, happy speakers may engage in less elaborate and less systematic processing of the visual referential context. Such a proposal is in line with findings that happy individuals tend to process the gist of visual scenes at the expense of details (Gasper & Clore, 2002), and also tend to be less accurate in face recognition (Hills, Werno & Lewis, 2011). In our experiments, happy speakers may have been less likely to spot the potential for ambiguity in the first place when inspecting the visual arrays. Indeed, in Experiment 2, there was a systematic difference between the ambiguous and the unambiguous (filler) visual contexts: Only the former, but not the latter, contained duplicate objects. A less elaborate visual processing style associated with induced happiness may have caused participants to overlook those duplicates and to fail to notice the potential for ambiguity. However, an explanation that invokes lack of attention to detail in visual processing is problematic for Experiment 1 where the ambiguity only becomes apparent at the stage of lexical access, rather than at the stage of visual processing of the configuration or the details of the depicted objects – after all, control arrays and arrays with homonyms both contained four different objects.

Another possibility, already mentioned above, is that the less deliberate processing style associated with happiness affects language production by impairing Theory of Mind and perspective taking (Converse et al., 2008; Epley et al., 2004). Such effects of emotional states on perspective taking have been demonstrated in comprehension (Converse et al., 2008). Our findings suggest that they may also impact production: If happy speakers fail to detect misalignment between their own and the addressee’s perspective they may be more prone to speed up the production process, in line with findings that addressee feedback signalling anticipation of referents triggers facilitation of production processes, as evidenced by faster onset and acoustic reduction of initial parts of an utterance (Arnold, Kahn & Pancani, 2012).

However, even though positive affective states are commonly associated with faster speech rate (Scherer, 2003), imposing a time constraint does not necessarily have to limit the cognitive resources available for production. For example, imposing deadlines in language production does not impair phonological planning (Damian & Dumay, 2007) or speech error monitoring (Oomen & Postma, 2001). This makes it unlikely that a general speeding up of the production process during happy mood is responsible for increased ambiguity.

The other possibility is that emotional valence affects speech monitoring at later stages of processing (Horton & Keysar, 1996). Happy speakers may not only fail to identify an addressee's perspective as different from their own but may also be less likely to monitor how well their utterances are aligned with an addressee's perspective thereby letting more ambiguity 'slip' through the monitor. An interesting question is whether positive affective states impair speech monitoring because of depletion of cognitive resources or because of strategic biases affecting processing style. Evidence from behavioural and neuroimaging studies suggests that positive emotional valence, while depleting the central executive (Oaksford et al., 1996; Phillips et al., 2002), may actually increase resources for verbal processing: Approach-related emotional states have been shown to facilitate verbal working memory whereas withdrawal-related emotional states facilitate spatial working memory (Gray, 2001; Storbeck, 2012), supporting proposals that emotional valence can exert specific lateralized effects in prefrontal cortex (Gray, Braver & Raichle, 2002). Based on these findings, one would predict enhanced resources for verbal tasks, a prediction that is incompatible with the increased ambiguity in the utterances of happy speakers observed in this study. We therefore would like to suggest that reduced monitoring of perspective alignment and the resulting increased ambiguity during positive affective states may take place not because of resource depletion but because of reliance on readily accessible defaults in judgment (Clore & Huntsinger, 2007), such as stereotypes about an addressee or egocentric bias. This is also in line with the aforementioned signal-detection analysis of estimated vs. actual communicative success by Fay et al. (2009), which showed that low anxiety speakers were biased to over-estimate their communicative success. More generally, our findings are compatible with an 'affect-as-information' approach according to which an individual's present affective state can influence cognitive style and processing priorities: perceived positive affect signals safety and justifies reliance on heuristics whereas perceived negative affect signals danger and encourages effortful and systematic processing (Schwarz & Clore, 1988). With respect to language production this means that positive affect may support reliance on egocentric biases with respect to an addressee's perspective therefore diminishing the perceived need for effortful speech monitoring.

To our knowledge, our study is the first to demonstrate an effect of affective valence on language production, and provides preliminary evidence that positive mood may hinder communication as happy speakers appear to be not only less polite but also less clear and, therefore, less cooperative. This finding provides further insights into sources of systematic speaker variability in audience design, i.e. the degree of alignment of structure, content and prosody of referring expressions with the inferred mental states of addressees. It challenges the assumption that audience design is a ubiquitous component of early processing stages in production (Nadig & Sedivy, 2002) by supporting the idea that audience design depends not only in contextual, but also on speaker variables (Schober & Brennan, 2003) of which affective state may be one.

The preliminary evidence for a link between happy mood and ambiguity in referring expressions reported here will hopefully inspire further research into the effects of emotion on language production. Future studies should employ more powerful methods of mood induction to explore the effects of sad mood on ambiguity production. Moreover, future research should seek direct empirical support for the mechanisms that may underlie increased ambiguity production during happy mood to paint a more detailed picture about the specific loci of effects of emotion in language production.

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Table 1: Mean proportions of bare homophones for targets in the control arrays and for targets and foils in the ambiguous arrays as a function of participant mood. Means and standard deviations (in parentheses) are computed across participants and items.

	control arrays	ambiguous arrays	
	target (3rd position)	target (3rd position)	foil (4th position)
speaker mood:			
happy	0.77 (0.42)	0.65 (0.48)	0.53 (0.50)
sad	0.78 (0.42)	0.68 (0.47)	0.34 (0.47)

Table 2: Mean proportions of unreduced relative clauses containing the demonstrative pronoun *that* (top part of table) and of omitted relative clauses (bottom part of table) for sentences requiring direct vs. oblique object modification as a function of participant mood. Means and standard deviations (in parentheses) are computed across participants and items.

	object modified	
	direct	oblique
	unreduced relative clauses	
speaker mood:		
happy	0.26 (0.44)	0.30 (0.46)
sad	0.34 (0.48)	0.34 (0.48)
	omitted object modifiers	
speaker mood:		
happy	0.42 (0.49)	0.45 (0.5)
sad	0.21 (0.41)	0.23 (0.42

Figure 1: Examples of visual arrays presented in Experiment 2. The top panels correspond to instructions to be given to potential listeners requiring modification of a direct object (top left panel) as in *Put the shark (that's) underneath the shoe underneath the sheep* or of an oblique object (top right panel) as in *Put the shark above the shoe (that's) above the sheep*. The bottom panels correspond to complex fillers (bottom left panel) as in *Put the shark underneath the sheep and the shoe above the sheep* and to simple fillers (bottom right panel) as in *Put the sheep above the pen*.